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GENERAL DYNAMICS | CONVAIR

Report No. 8926-139

Material - Sealants - Fuel Tank

Elevated Temperature and Fuel Resistance

R. R. Reschan, E. E. Keller, W. M. Sutherland

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Elevated Temperature and Fuel Resistance

Abstract:

State of art review during 1958 showed that rubber-like, room temperature curing, fillet forming tank sealants were limited to use in the 275 to 300°F. temperature range. Progress during 1957 resulted in the development of General Electric Co. R.T.V. Silicones which would withstand temperatures up to 500°F., but could not withstand hydrocarbon fuel impingement. Hydrocarbon fuel resistance was not improved in these materials during 1958. Development progress with sealants based on DuPont Viton A synthetic elastomer were reported during the year, but the development of this material, which is useful to 450°F, was not complete at the year's end.

Reference: Reschan, R. R. Keller, E. E., Sutherland, W. M.,  
"Elevated Temperature Tank Sealing Materials," General  
Dynamics/Convair Report MP 58-074, San Diego, California,  
28 January 1959 (Reference attached).



ANALYSIS  
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PAGE 1  
REPORT NO. MP 58-074  
MODEL REA 7038  
DATE 1-28-59

INTRODUCTION:

A search for high temperature resistant materials to be used in the construction of present and future aircraft continues at an accelerated pace. One such material necessary for this type of construction is a high temperature resistant fuel tank sealant. This report covers information obtained on the research and development to the present time of high temperature resistant rubber like compounds for fuel tank sealing.

OBJECT:

The prime objective of this investigation was to conduct a search, through vendor contacts and literature survey, for the latest information obtainable in the development of satisfactory high temperature sealing materials for use in aircraft utilizing integral fuel tanks.

CONCLUSIONS:

1. Present state of the art of elevated temperature fuel tank sealing with rubber compounds continues to be limited in temperature to a maximum range of 275° to 300°F. There has been no rubber like, room temperature curing, fillet type material developed and commercially available which could be used as a fuel tank sealant in the temperature ranges of 500° to 1000°F.
2. In last years' Report No. 57-197 it was reported that the RTV Silicone elastomers produced by the Silicones Division of General Electric Co. have good 500°F. temperature resistant properties but are not resistant to jet fuel. At the present time these are the only room temperature vulcanizing materials available which have a temperature resistance above the 275°F. Mil-S-8802 materials now being used by the aircraft industry.
3. Much progress has been made by various companies in attempts to compound filleting, fill and drain, and groove injection sealing materials based on DuPont's Viton A, for use at temperatures to 450°F,
4. The present maximum temperature of qualified fuel tank sealing compounds commercially available to the aircraft industry is 275°F.

DISCUSSION:

1. In September of 1958, the General Electric Co. announced in a newsletter that it had developed a room temperature vulcanizing silicone nitrile rubber which is resistant to boiling jet fuel and temperatures up to 550°F.

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PAGE 2  
REPORT NO. MP 58-074  
MODEL REA 7038  
DATE 1-28-59

DISCUSSION: (Continued)

An attempt was made to obtain a sample for testing, None was available however, since the material was still in the research stage. Test samples of this nitrile rubber will be made available the first part of 1959. If proven in subsequent testing, the development of this material would be a major step forward in extending the temperature range of rubber sealing compounds.

2. Du Pont's Viton A, a heat stable fluorinated polymer continues to hold the most promise as a material which may be compounded into a filleting type sealing material for use at temperatures to 450°F. Compounds developed at present from the Viton A polymer are still in the laboratory research stage and require more development work before they are commercially available.
3. A WADC Technical Report No. 57-651 released in June 1958 reveals that considerable progress has been made by Products Research Co., Los Angeles, Calif. in the compounding of Viton A into fillet, fill and drain, and groove injection type sealing materials for use at temperatures of 450°F. The fill and drain, and groove injection compounds are reported as being the most promising at the present time. A little more development work, is required before samples of these materials will be available for testing. The 80 to 100% solids fillet type compounds require more research in an attempt to gain greater tensile strength properties, and an adequate primer system for good adhesion to metal such as stainless steel and titanium.
4. In all cases where Viton A has been compounded with a fair amount of success into a sealing material, a heat cure from 100° to 450°F. over a period of several days has been necessary to establish proper cure of the material.
5. Reports containing the latest information in the research and development of fuel tank elastomers are listed in Table I.

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PAGE 3  
REPORT NO. MP 58-074  
MODEL REA 7038  
DATE 1-28-59

TABLE I

The following is a list of WADC Reports released over the past eighteen months covering work done by various companies in the development and testing of high temperature sealant materials:

NO.	TEST REPORT NO.	TITLE	COMPANY
1	TR 58-89	Development of High Temperature Sealants	Products Research Co.
2	TR 55-220 Part IV	Development of Fluoro-Silicone Elastomers	Peninsular Chem- Research Inc.
3	TR 56-331	Development of High Temperature Resistant Rubber Compounds	The Firestone Tire and Rubber Co.
4	TR 55-492 Part I, II, III	Development and Physical Testing of Elastomeric Compounds Resistant to Petroleum Base Fuels at Elevated temperatures	Wyandotte Chemical Corp.
5	TR 55-221	Investigation of Condensation Type Elastomers	Hooker Electrochem- ical Co.
6	TR 57-651	Development of Rubberlike Materials for Applications Involving Contact with Liquid Rocket Propellants	The Connecticut Hard Rubber Co.
7	TR 57-247	The Micro-Compounding and Evaluation of Rubber-like Polymers	WADC Materials Laboratory
8	TR 56-155	High Temperature Resistant Sealant Materials	Coast Pro-Seal and Manufacturing Co.
9	TR 56-351	Effect of Potential Rocket Fuels and Oxidizers on Elastomers and Development of Compounds Suitable for Retention	The Connecticut Hard Rubber Co.